SESSION 3

ON AND OFF FARM DISPOSAL OF WASTE AND PACKAGING

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OFF-FARM DISPOSAL - CONTAMINATED PACKAGING AND MATERIALS

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ABSTRACT

The concept of Producer Responsibility is accelerating a revolution in the way in which product manufacturers and suppliers (PMSs) view the packaging and pricing of their materials. The impact of this process varies across different industry sectors - but where the packaging or material stream is classified as potentially hazardous the incentives to develop effective audit trails and retrieval systems is most apparent.

The cost effectiveness of these systems is a function of scale in developing efficient end of life recovery logistics. Farms - by their very nature - present a particularly challenging area. The objective is to maximise those scale economies in ways which drive down the unit packaging cost - once the decision to reclaim end of life materials has been taken in preference to in-situ disposal. Sometimes those retrieval systems can be accelerated by cross sectoral cooperation aimed at achieving complete transparency for the agrochemical industry in terms of logistics and end life disposal costs. The UK has the infrastructure to cope with these challenges.

THE LEGISLATIVE FRAMEWORK

End of pipe pressures

End of pipe pressures take the form of a widening regime of regulatory and fiscal threats to the disposal of material through what are considered to be environmentally unfriendly exit routes for end of life materials. In consequence there is a preference for landfill taxes and end of life disposal taxes to encourage the diversion of material toward Best or Better Practical Environmental Options (BPEOs). Fiscal pressures apart there may also be outright bans on the disposal of certain materials direct to landfill with a widening in the range of packaging and specific products which have to be subject to high temperature incineration. This is significant in so far as - in 1993 - typical landfill gate prices were £8 per tonne whereas in 1998 tax inclusive gate fees for high temperature incineration are (subject to toxicity ratings) £300 per tonne and upwards.

Hazardous materials are also subject to extended proscription on their end life disposal and localised in-situ burning in the agricultural sector is likely to come under increasing scrutiny and pressure.

Front of pipe issues

These are represented by the concept of Producer Responsibility. There are growing cases where government pressure is being exerted on manufacturing sectors to take responsibility for funding all or part of the end life reclamation of their product once it has come to the end of its useful life. This applies both to product and its packaging. Examples include industrial, commercial, domestic and (potentially in coming years) electrical and electronics goods, automotive equipment, oil, domestic hazardous wastes and batteries. Thus far agrochemicals, pharmaceuticals and chemicals in general have met this challenge pro-actively.

WHY BOTHER?

General concern operates in respect of the way the industrialised society has used resources in a linear sense (extract, use, dispose). This process has led to a belief that the environmental tolerance levels of the planet to absorb disposals - in terms of air, solid and liquid byproducts - are now reaching levels which are triggering uncertain climatic, oceanic and other impacts. Particular concerns operate in relation to carbon dioxide, heavy metals and a wide variety of organic chemicals subject to diffused and/or specific pollution potential. This has led to the concept of "zero impact" philosophies for specific material streams - or the development of targets over specified time intervals operated with appropriate measurement systems.

WHAT ARE THE KEY COST DRIVERS IN ACHIEVING ZERO IMPACTS OR TARGETS?

The incremental costs come in 2 forms:

- Logistics
- End life treatment

Logistics costs (collection and delivery to a specialist reprocessing/destruction plant) are a simple function of mass against kilometres run. The objective is to achieve high route density of collection at frequencies which balance convenience to the waste producer with viability for the waste collector. Such costs are minimised by developing a framework of clubs - or a single "club" - capable of standardising on contract specification and maximising purchasing strength.

End life destruction costs are a function of the technology selected. The current most likely candidate for agrochemical containers and residues is high temperature incineration in specialist plants licenced for that purpose. Burn temperatures in excess of 1300°C with long "dwell time" ensures the complete destruction of the long chain molecules often associated with these products. Gate fees can vary from £40 per tonne inclusive of tax to £200-£300 per tonne in specialist high temperature incineration plants. If material is burnt via energy from waste plants there is a probability of claw-back benefit in the form of Producer Responsibility Notes (PRNs) which are of benefit to the manufacturers and retailers of products as a means of meeting their Producer Responsibility Obligations on the packaging. It is not all bad news!

CROSS SECTORAL COOPERATION

Economies of scale can be enhanced further by developing cross links with other material sectors involved in the supply of farm materials. Producer Responsibility is likely to extend into a wide range of materials in general use on the farm and dialogue with the farmer's unions and trade associations can be important in developing those linkages to the benefit of all. Specialist contractors should have an inbuilt interest in maximising that scale as a means of improving the overall commercial attractiveness of the logistics solution finally adopted.

METHODS OF OPERATION

The key elements of a viable reclamation system are:

- simplicity
- bulking up arrangements (for instance through cooperatives)
- mass diminution (by compaction or shredding)
- long term contracts to underwrite innovative capital investment
- flexibility in handling systems
- commercial transparency
- audit trails
- legislative compliance

CONCLUSION

The development of an integrated end of life reclamation chain for unwanted product and packaging from the agrochemicals sector needs to be developed on a round-table pro-active basis between different sectors - including waste treatment specialists with a national infrastructure capability. Whilst these systems may bring increments in cost as a percentage of overall turnover, the sums involved are not necessarily significant. The environmental benefit of introducing these benefits are substantial and will place the agricultural industry in a less vulnerable position from criticism from environmentalists, the media and the general public. It is in everybody's interests to develop internally led solutions to these needs in advance of the possible introduction of proscriptive measures imposed as a result of regulatory or legislative diktat.

EFFECTIVE CONTAINER CLEANING FOR CROP PROTECTION PRODUCTS

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ABSTRACT

Containers used for Crop Protection Products (CPP's) should be cleaned immediately after use as one integral step in preparing to spray. In most cases, cleaning entails first emptying then rinsing. Common-sense considerations make the case for container cleaning. It maximises placement of the CPP on target, saves money, and earns a "non-hazardous" classification for the container. Container cleaning is also an important element in the industry's Container Management Strategy. To maximise practical adoption of container cleaning, a series of measures should be promoted; quality container designs, appropriate container capacities, availability of rinsing equipment and effective promotion to spray operators and growers. Laboratory determinations of "rinsing levels" are useful to make relative comparisons (e.g. between two container designs) but they cannot be clearly related to hazard or risk. The paper identifies a series of measures as current priorities in Europe to increase adoption of container rinsing. These require action by both manufacturers and official bodies.

PURPOSE AND SCOPE

This paper reviews the subject of container cleaning for Crop Protection Products (CPP's). Its prime focus is Europe.

The areas covered are:

* Rationale for cleaning.
* Fundamental concepts.
* Accumulated research knowledge on container cleaning performance.
* Key issues.
* Strategies to improve practical on-farm cleaning.

Container cleaning is normally a two-step process - emptying (draining in the case of liquid formulations) then rinsing. It should be noted that the rinsing recommendations apply only to products which are rinsable, i.e. comprising combinations of formulations (liquid or solid) intended for dilution in water in containers (rigid or flexible) which allow rinsing.

It is not the paper's goal to give detailed instructions on rinsing methodology. However, some discussion of methods will be essential to examine how meaningful rinsing data are.

[1]The author is Chairman of the ECPA Packaging Expert Group. The paper is not necessarily a statement of policy from ECPA.

RATIONALE FOR ON-FARM CONTAINER CLEANING

The rest of the paper will review some of the more subtle issues associated with rinsing but the rationale to clean the container is founded on the simplest common-sense concepts:

* Save your money! This is obviously a powerful motivator at farmer level and the prime message for promotional campaigns.

  Ogilvy (1994), calculated that for one product £5.00 worth of formulation per container could remain in an uncleaned container.

  Laboratory studies (Eyre, 1997) have shown that, with more viscous formulations, in excess of 7% of product can remain in containers after emptying and draining for 30 seconds. Under field conditions, the figure could be even higher, so the value at stake is significant.

* Put the chemical on-target, not off-target. It is generally accepted that all practicable steps should be taken to minimise quantities of CPP going off-target. Failure to rinse effectively places more of the CPP off-target. It obviously makes sense to adopt this principle as a standard working practice across-the-board rather than compound-by-compound.

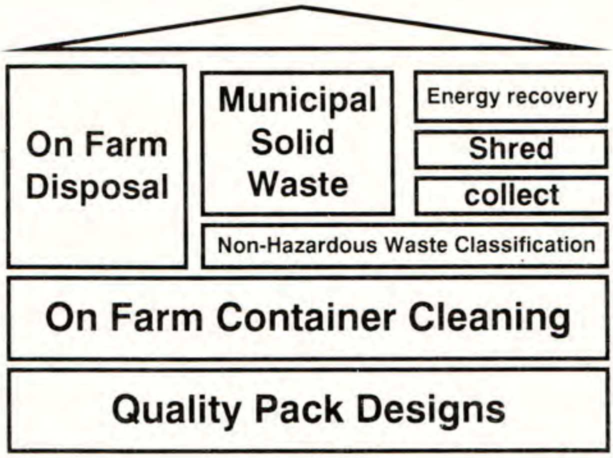
  Proper cleaning of containers and management of washings is essential to prevent contamination of water bodies.

* Get the container clean to qualify for a "non hazardous classification". The cleaning procedure will "decontaminate" the contaminated container. Cleaned containers become "waste" as mixed loads. This material should qualify as non-hazardous waste and, in a practical sense, the cleaning procedures avoid potential hazards during the stages of waste transportation and handling (Smith, 1998).

  It should be noted that being "non-hazardous" for these operations in no way qualifies the material to be used indiscriminately for new end users. This requires a separate assessment.

A companion paper (Smith, 1998) explains why container cleaning is a critical "building block" in the overall strategy for container management set out by the European Crop Protection Association (ECPA) (Anon. 1997c) (Figure 1).

Figure 1. ECPA container management strategy - three[2] approaches for recovery/disposal



The strategy precludes scenarios where used containers would enter unknown or uncontrolled waste streams. All three supported approaches for final treatment qualify as "closed channels".

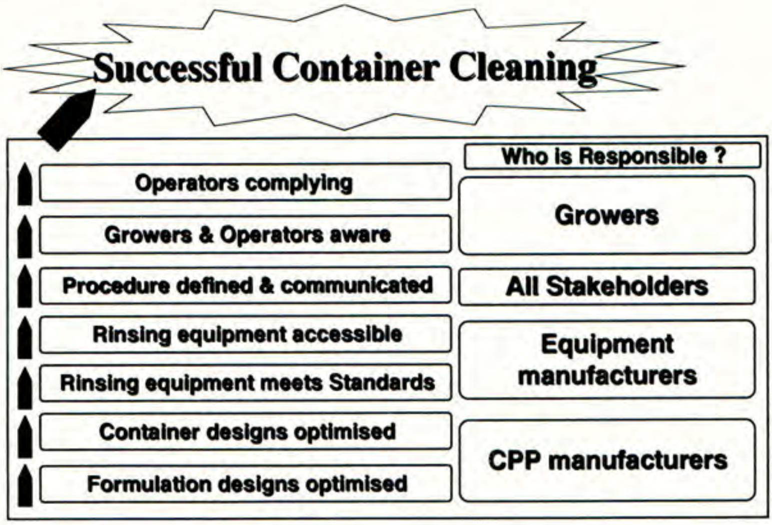
This paper takes this as a basic premise when discussing the significance of residues in containers.

[2] The three approaches are not arranged here in a hierarchy. The text discusses ranking of the options and how to select for particular circumstances.

ON-FARM CONTAINER CLEANING - THE BUILDING BLOCKS FOR SUCCESS

Successful rinsing is the result of a series of activities involving different stakeholders (Figure 2).

Figure 2. Successful container cleaning - the building blocks and responsibilities



It is vital to recognise that initiatives applied at just one point in the chain will not deliver the required outcome. If the container designs are poor, even well trained sprayer operators will fail to achieve clean containers. Similarly, if operators fail to rinse, even well designed containers will be significantly contaminated. The next sections explain the measures needed to both:

* Maximise products' inherent capability to be cleaned and
* Maximise practical compliance with cleaning procedures be easing the task facing operators - this is a critical success factor.

Successful container cleaning requires that these measures be implemented <u>as a set</u> in a <u>co-ordinated</u> manner.

The Netherlands provides an exemplar of how to achieve high levels of adoption in practice (Anon. 1992a). Key elements:

* A design standard for rinsing equipment.
* A legal requirement that new sprayers[3] are fitted with rinsing equipment as standard.
* A legal requirement on growers to carry-out rinsing.

[3] More precisely, all sprayers with capacities exceeding 21 litres to have access to rinsing equipment.

In the Netherlands, container cleaning is practised on a large scale thanks to this package of measures. In many European countries much remains to be done to emulate this model.

Quality product designs

The first building block for successful cleaning is to achieve quality design of the products, i.e. the combination of formulation and container. This is a generally accepted goal for major CPP manufacturers engaged in new product development. Historically, certain container designs frustrated attempts to empty the contents fully and rinse effectively. In recent years, the industry has set a design guideline specifically dealing with the container's capability to be cleaned.

> *"1. Basic Requirements"*
>
> .....The container..... *"should drain well and allow easy and effective rinsing to maximise product residue removal"*.....
>
> (Anon. 1997a)

During the last ten years, old designs of CPP containers have been displaced by new ones which meet this industry guideline.

The best containers have these design features; wide neck, "funnel" shape, and no residue trapping areas such as certain hollow handle designs.

Often, optimising this "whole product design" will require that a sensible balance is struck between conflicting requirements. Examples:

* A shift from an emulsifiable concentrate (EC) formulation to a capsule suspension (CS) is likely to enhance operator safety yet may make cleaning more difficult.

* Maximising a.i. concentration will reduce total quantities of packaging waste yet may (with suspensions) thicken the formulation making cleaning more difficult.

Hence whilst greater attention should be paid to improving the inherent rinsability of products, this should not be pursued blindly without regard to other design characteristics which might deserve greater weight.

Attention to container design does not only impact inherent rinsability. Clear or translucent containers can be selected to encourage compliance by users and facilitate audits by inspectors (see over).

Matching container capacity to the needs of the applicator

Container rinsing becomes burdensome if the applicator is faced with a large number of containers. Sometimes, 1 litre containers are currently used in situations where a larger capacity unit (e.g. 10 litre) would considerably reduce required cleaning time.

Ogilvy (1997) compared the time[4] required to clean 10 litre and 1 litre containers for the scenario of a 20 ha treatment using 1 litre/ha. The measured times for cleaning were (min:s):

	Triple manual	Pressure integrated
* 1 litre (20 containers)	42:04	22:28
* 10 litre (2 containers)	7:46	3:17

Matching container size to users can only be done in specific situations. It is important that these practical requirements at the handling and application stages are given due weight when specifying container sizes at the time of product purchase. For their part, manufacturers should take due account of this aspect of the usage patterns when deciding which container size(s) to market.

Rinsing equipment

Two types of rinsing method are promoted:

* Manual rinsing - the "triple rinse" method.
* Pressure rinsing - ideally using "integrated pressure rinsing equipment".

Manual rinsing is very laborious. Hence, it is appropriate primarily for smaller containers (e.g. 1 litre or less), non-standard containers, and very small farms.

For larger farms and the more typical standard container systems (5 litre and 10 litre containers for liquids), it is important that the burden of container cleaning is minimised to an acceptable level by provision of integrated pressure rinsing devices (Ogilvy, 1994). These may be free-standing or fitted to the sprayer. They combine an induction hopper plus a rinsing probe with a static or rotary nozzle.

A practical rinsing procedure for use at field level

The origins of the triple rinse procedures can be traced back to long standing, generally accepted procedures for cleaning laboratory equipment. Importantly this procedure sets out to produce "acceptably" clean vessels rather than claiming to remove all traces. Indeed, the spectacular advances in analytical methods have transformed our notion of what constitutes trace quantities. Thus, the CPP triple rinse procedure is simply a serial dilution process modified for the CPP product situation.

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[4] The procedure conformed to the guidelines (Anon. 1993a) except that the drainage time for the rinsate was shortened.

The benefits of triple (as opposed to single or double) rinsing of CPP containers have been well documented by numerous studies in the USA dating back to the 1970s (Anon. 1992b). Integrated pressure rinsing equipment and procedures have largely been developed in Europe following the pioneering work by the Dutch Institute of Agricultural Engineering (IMAG) in the mid 1980's (Haghuis, 1985). Other published studies (Lavers (1993) and Mostade *et al.* (1997)) have confirmed the effectiveness and practicality of these devices with commercial CPP's.

Guidelines for the practical in-field rinsing of containers based on such detailed trial work have now been agreed by the industry. These have been published and widely disseminated by organisations in both North America and Europe. The standard reference in Europe is the booklet 'Guidelines for the Rinsing of Agrochemical Containers' published by the ECPA (Anon. 1993a) - see extract in Appendix 1.

Simplicity is the key to practical implementation. Hence, these rinsing procedures are intended to be adopted across-the-board for all CPP's. There is no desire to differentiate the recommendation to different classes of product.

Promoting container cleaning to growers and operators

The key messages to deliver to growers and operators are:

* Container cleaning makes sense (the rationale)
* Here is how it is done (methodology)
* Do it as part of the product use operation, not as a "pre-disposal" operation.

There are various means of communication. The process starts by including, on the product label, a specific recommendation to clean the container. However, the label is not the medium to generate motivation or to communicate details of the rinsing procedures. The medium to select will vary according to the situation and culture but may include television, radio and live presentations.

National Associations of the CPP industry have run promotional campaigns building on ECPA Guidelines. For example, in the UK, the British Agrochemical Association (BAA) has prepared a rinsing leaflet (Anon. 1994a), a disposal leaflet (Anon. 1994b), and a sticker (Anon. 1996) to attach to the spray tank. According to a recent survey, 80% rinsing compliance was achieved (Anon. 1997b). In Germany, practical compliance with on-farm cleaning was visually assessed at container collection sites. 85% were acceptably clean during early pilot programmes (Döhnert, 1994) and this is likely to have increased with the subsequent growth in awareness.

Based on international experience, growers readily accept the rationale for rinsing. However, active encouragement and promotion is needed. For example, in successful container collection programmes, samples of containers are visually inspected to confirm cleanliness as a qualification for acceptance into the scheme. This is recognised as a very powerful reinforcement for grower compliance with rinsing.

Experience shows that clear or translucent containers can be a further aid to effective cleaning. Sprayer operators can more easily determine visually when a container is adequately washed. Then if collection schemes are implemented, inspectors can readily assess compliance with cleaning.

CLEANING - HOW EFFECTIVE IS IT? HOW SIGNIFICANT ARE RESIDUES REMAINING IN THE CONTAINER?

Having discussed rinsing as a common-sense procedure, this section discusses the subject of "rinsing levels" and residues. In particular, it focuses on their significance to hazard and risk as well as their relationship to any legally established levels.

First, how effective is container rinsing?

In order to judge rinsing performance, researchers have referred to recognised "rinsing levels" as indicators of performance. In Europe the Dutch 99.99% residue removal target has been the most widely used reference point (more commonly expressed as the inverse; 0.01% of original contents remaining). At the time it was set, this was a pragmatically based limit value allowing entry of waste[5] into municipal waste streams which are considered to be non-hazardous. In these tests, the quantity remaining has been assessed by measuring the quantity of product (normally a.i.) present in an "assay rinse" performed after the normal field cleaning procedure.

Manufacturers have conducted rinsing studies on selected products. Industry associations (e.g. ECPA) have analysed these data (preserving confidentiality for participating companies) to extract generic lessons.

Broadly speaking, modern designs of CPP and formulations have taken into account the requirement for good rinsability as demonstrated by the % remaining residue after a final aqueous or solvent rinse. For example, in a survey of results of ECPA members (Anon. 1993b), encompassing some 11 programmes and 197 tests, it was shown that in over 90% of cases, the % of original contents remaining in the containers after rinsing was 0.01% or less (see Table 2).

Table 2. ECPA container rinsing survey results (as % of original contents)

Rinsing method	Triple	Pressure	Total
No of tests	41	156	197
No of results <0.01%	38	142	180
% of tests with <0.01%	92.7	91.0	

Source: ECPA - PTF survey.

[5] To be precise, the Dutch provisions excluded products in the highest toxicological category.

The examples of "under-performance" were associated with highly viscous suspension formulations (e.g. SC or CS). In these cases, the residues were readily visible (if the container is clear or translucent).

This is not to say that these shortfalls constitute any meaningful risk - an issue examined below.

Secondly, how are results affected by the methods used?

When research data are examined in greater detail, it is clear that results are affected significantly depending on the methods used (Table 1).

Table 1. Rinsing performance of 'Bladex' in 5 litre HDPE container using different rinsing methods. Results as % of total original contents

Rinse method/ nozzle type	Rinse time (seconds)	Final rinsate (concg/litre)	Residue %
Pressure/Cluster	30	0.0247	0.0049
Pressure/Cluster	15	0.0559	0.0112
Pressure/Rotary	3 x 10	0.1032	0.0206
Triple rinse manual	3 x 10	0.0040	0.0008

Source: Lavers, 1993

Other method factors which are known to have a significant influence on research results include how the container is held during the rinse cycle (pressure rinsing), if the closure is included and, with certain formulations, the time interval between draining and rinsing.

The observed rinsing levels are affected considerably depending on whether an aqueous or non-aqueous solvent is used for the assay rinse. Some researchers have opted for an aqueous solvent on the basis that this reflects field practice whereas others have opted for a non-aqueous solvent on the grounds this would be a more effective means of removing hard-to-remove residues. This latter approach has been adopted as the standard industry procedure (Anon. 1993c).

Table 3 illustrates the quantities of a.i. from a triple rinsing study performed with 2 different products where the 3rd aqueous rinse and an assay non-aqueous solvent rinse were analysed separately (Tierman, 1990).

Table 3. Triple rinse - results from tests with 2.5 US gal (9.47 litres) containers

Rinse no	Mass a.i. rinsate mg	a.i. conc g/l	a.i. remaining (%)	Mass a.i. remaining in container
Atrazine 4 l original a.i. = 479.306 g/l = 4539 g/container				
3	7.28	0.0072	0.0020	0.0908 g
4	1.41	0.0014	0.0003	0.0136 g
2, 4-D Amine original a.i. = 479.306 g/l = 4539 g/container				
3	0.30	0.0003	0.00006	0.00273 g
4	0.01	0.00001	0.00001	0.00045 g

Source: T O Tierman

Inevitably, even a non-aqueous rinse will not remove all residues. Some residues may migrate in to the container walls. These may be regarded as "bound - present, but hard to remove.

To assay quantities of a.i. migrated into container walls is a big challenge for the analytical chemist. It requires specialised cryogenic grinding of container walls, solvent extractions then chromatographic determinations. Whilst a few pioneering investigations have been made, these are a long way from being standard procedures.

Thirdly, how far can rinsing levels be related to real-life hazard and risk?

Rinsing levels (like the Dutch 99.99% residue removal target) have been used widely by researchers as a performance standard but this has almost always been taken as an arbitrary level, certainly useful for relative comparisons (e.g. between containers) but with no claimed association to hazard and risk.

One study reported from Italy (Anon. 1995) is a notable exception where the author refers to a concept by Leoni linking the container residue level to the highest maximum residue limit (MRL) set for the a.i. in each case. MRL's have been set in the context of dietary exposure to CPP's. Hence, to be meaningful for the situation of CPP containers, one would have to invoke some exposure scenario whereby residues in the containers were ingested.

This paper argues that hazard and risk can only be considered in the context of exposure scenarios so, by definition, rinsing levels in isolation are meaningless with respect to hazard and risk.

It is possible to speculate on scenarios whereby the intact or reprocessed container material might present some hazard. However, all these (at least those known to the author) would be in violation of the ECPA guidelines (Anon. 1997c) with its "closed channel" provision.

Finally, given our knowledge of container cleaning, what is the status of the cleaned container with regard to legally established systems for waste classification.

Döhnert (1997) has assessed the relevance of remaining residues to "limit concentrations" set in the EU Hazardous Waste Directive.

This is the most appropriate regulation to consider since it will ultimately take effect in all European member states, where necessary requiring harmonisation of long-standing national regulations. This assessment showed that agrochemical containers, rinsed but containing residues, clearly fall outside the hazardous waste category. The detailed assumptions are given in the footnote[6]. The industry believes that containers cleaned according to the recommended procedures qualify (as in USA) for a non-hazardous classification. Industry work groups should continue to accumulate and share knowledge on container residues in order that this position can be kept under review.

SUCCESSFUL CLEANING - THEN WHAT?

Successful cleaning provides a basis for the next stage of container management, e.g. collection or on-farm disposal (Smith, 1998). However, after cleaning, the grower (or his appointee) should assume the role of responsible "waste holder" for any storage and movements of empty containers until they are taken by a competent appointed person charged with the next stage. Adhering to these arrangements ensures that the closed channel principle (Smith, 1998) is upheld.

CONCLUSION AND FUTURE STEPS

Container cleaning must be energetically promoted as a common-sense practice which saves money and places CPP's on-target.

Assurances of safety to man and the environment come from the combination of:

* Effective cleaning.
* "closed-channel" arrangements for waste handling, transport, then final treatment.

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[6] Assumptions and calculations performed by Döhnert (1997) and the author:

* Hazardous properties are considered to apply to a.i.
* Container is 5 litre capacity weighing 280 g when empty.
* Rinsing effectiveness = 99.99% residue removal (excluding 'bound' material). Amount bound) remaining = 0.25 g.
* "Bound" residue remaining after rinsing = 500 ppm with respect to the container weight (considered an extreme upper limit based on manufacturers experience) or 0.14 g in absolute terms.
* Sum of unbound and bound residue = 0.14% expressed as % of container weight.
* This is 22 times lower than the EU limit value set for substances classified as "toxic" and 180 times lower than the level set for substances classified as "harmful".
* CPP containers become "waste", not as pure product streams but as mixed container loads.

The precise level of rinsing is not a significant consideration in providing these assurances. Laboratory rinsing assays and threshold levels have some value as a relative measure, e.g. to compare two alternative container designs in a controlled experiment holding other variables constant, but should not be misinterpreted as being meaningful for determinations of hazard or assessment of risk. The manufacturers, official agencies and the supply chain should channel energy to maximising practical container cleaning at farm level.

Key measures to promote cleaning have already been communicated (Anon. 1993a, Anon. 1997c). The author believes the following actions are currently high priorities.

Action	**Responsible**
Update the industry's shared database on container cleaning assays. Extract generic learning. Keep under review relevance to practical hazard and risk and to any legally set levels relevant to waste classification. Consider generating new data if warranted.	Manufacturers (ECPA)
Building on existing published documents (e.g. Anon. 1993a), update and communicate best practice for field level container cleaning. Consider broadening scope to address more specifically the "non-bottle" elements of the packaging system and containers with capacities greater than 10 litres.	Manufacturers (ECPA)
Review container capacities with respect to user requirement for the practical spraying operation.	Manufacturers (ECPA)
Ensure best practice for container cleaning is built into sprayer operator training courses.	Official Bodies
Stimulate field compliance with rinsing recommendations.	Official Bodies
Ensure field equipment performance meets recognised standards.	Equipment Manufacturers

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APPENDIX 1

Extract from ECPA booklet : Guidelines for rinsing of agrochemical containers (Anon, 1993a)

Triple rinsing

To triple rinse, allow the contents of the pack to drain for an extra 30 seconds when emptying. Then fill the container to between 20-25% of its capacity with clean water. Replace the cap securely and shake, rotate, roll or invert the container so that the rinse reaches all the inside surfaces, then drain the rinse water into the spray tank (drain time recommended 30 seconds). Repeat the process at least twice until the container is visually clean.

Integrated rinsing

Integrated rinsing equipment should be used wherever possible as it represents a quicker and more efficient method of rinsing containers and provides a good level of operator safety. These devices rinse by using water under pressure of typically 3-5 bar and employ a static or rotating spray nozzle with a valve and are normally built into the induction hopper of the sprayer. The container is cleaned by the water pressure until no visible residues are detectable (typically requiring up to 30 seconds and 15 litres of water) and the rinsate is added to the spray liquid. Integrated rinsing devices can be built into a closed chemical transfer system and these can provide both efficient rinsing and even greater operator safety. A comparison of the rinsing methods shows certain advantages for the integrated system because the containers do not have to be manually moved* which can lead to spillage and contamination of the operator.

It is important to understands that whichever method is used the rinsate must always be added to the spray solution. Closures can be rinsed by placing them in the induction hopper. With triple rinsing they are cleaned by the shaking process.

Manufacturers' instructions should be followed when using any rinsing equipment.

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* Author's note : This does not apply to some devices now available which require the container to be moved during rinsing.

THE SAFE DISPOSAL OF CLEAN AGROCHEMICAL CONTAINERS ON FARM - AN INTERIM REPORT

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INTRODUCTION

The British Agrochemicals Association (BAA) is completing its research programme to identify the most appropriate ways in which to dispose of cleaned agrochemical containers. The BAA believes that all alternatives should be considered before deciding on the best environmental option. It is concerned that a recovery scheme such as those introduced in Germany and America may not be the best option, as these could incur problems of waste accumulation and transport producing significant extra costs for the farmer without proven environmental benefits.

This paper is the first of two papers based on BAA's research to date into on-farm disposal and looks at the scale of the UK problem, the current and possible future legislation affecting waste disposal on farm, current farmer practice, the attitudes of district councils and the difficulties associated with burial and outstanding research needs.

The second paper "Facts and perspectives on the incineration of clean agrochemical containers on farm" gives a more detailed analysis of the research into container incineration and its chemistry.

The two papers draw from the draft of a more detailed report "The safe disposal of clean agrochemical containers on farm" being prepared by BAA.

The scale of the problem

BAA statistics show that in 1995 over 13 million packs were supplied by manufacturing companies to the distributor trade. These same packs will have been delivered on to farms.

The industry has for many years been continuously improving container design and as a consequence reducing waste. This has been achieved by using lighter weight packaging, formulation changes, increased pack sizes and re-usable refillable containers. The Producer Responsibility Obligations Regulations introduced in 1996, sought to reduce the volume of packaging waste being put into the supply chain and has acted as a further incentive to the industry.

Nevertheless it is estimated that over 4000 tonnes of agrochemical packaging is delivered to farms and end up as waste. This represents about 5% of packaging delivered on to farms every year and an even smaller percentage of the UK total packaging waste of 10 million tonnes. Although agrochemical containers are only a small part of the UK's packaging waste, the nature of their original contents can raise concern over the appropriate route of disposal.

The Legislation Affecting the Disposal of Agrochemical Containers on Farm

There are a number of legislative arrangements which control the disposal of waste on farm. The principle source of advice is that published in the statutory Code of Practice for the Safe Use of Pesticides on Farms and Holdings, however important advice on the colour of smoke is included in the Clean Air Act.

Due to an exemption in the Environmental Protection Act 1990, wastes arising on agricultural holdings are exempt from the requirements of this Act. If this exemption is removed then agricultural waste could become "controlled" waste and a "duty of care" placed on the owners of that waste. The owner is of course the grower.

The exact nature of the new responsibilities that could be put on farmers is unclear and would depend on the scope and detail in new UK legislation. An assessment of cleaned empty agrochemical containers under current waste legislation criteria shows that they should not be treated as special waste.

Interviews with District Councils on the Topic of Farm Bonfires

A small survey of District Councils Environmental Health Officers reviewed their attitudes to bonfires on farms. Officers referred to the Clean Air Act and the Environmental Protection Act as the principle pieces of legislation which they would refer to when dealing with bonfires. Nuisance and dark smoke were identified as the principle concerns.

All officers instinctively expressed a preference for waste disposal at a licensed waste disposal site as this was the way in which disposal was most carefully regulated. Officers did however recognise that a controlled burn was a satisfactory option. There was a poor understanding of the chemistry of burning clean agrochemical containers and officers feared that burning agrochemicals might produce dioxins. In the companion paper, a study of the molecular structure of the active ingredients supplied to the UK marketplace reveals that it was not possible to form dioxins.

Container Cleaning

Good and thorough container cleaning is essential for safe disposal whatever the route of disposal (Smith RK 1998.) In recognition of this the British Agrochemicals Association (BAA) commissioned a postal survey by the Central Science Laboratory to assess the level of farmer awareness and the degree to which farmers were cleaning their empty pesticide containers.

The survey was sent out to a stratified sample of 783 farms. 263 farmers responded giving a response rate of 33.6%. The survey showed that the overwhelming majority of farms over 150 ha in size have rinsing devices fitted to their sprayers. On those farms where such devices were not fitted the survey found that over 80% were already triple-rinsing their containers during the application process.

A complimentary study of spray operator skills by Hardi at the 1997 Spray and Sprayers Event tested the skills of 103 operators in cleaning containers. The results showed how pressure rinsing was very effective at cleaning containers and that practised operators were able to consistently clean containers.

Farmers/Farm Managers' Attitudes to On-Farm Burning of Agrochemical Containers

In a qualitative survey, interviews were carried out with fifteen farmers/farm managers on the subject of the burning of pesticide containers and packaging on farm. Fourteen carried out on farm burning and one had all containers collected by a registered waste disposal contractor.

This is consistent with previous research that showed over 70-80% farmers were burning, 20-30% burying and 0-10% using a waste disposal contractor. The majority of farmers stored containers prior to burning. Containers and other farm wastes were burnt at the same site. In recognition of advice in the Code of Practice, farmers were most concerned over smoke colour and proximity to buildings and roads.

Farmers were aware that the heat of the fire was critical to efficient burning, although their main concern was time spent on the site and the need to get the fire started quickly and easily. Commonsense attitudes to staying upwind of fires of any type was expressed due mostly to the discomfort caused by smoke.

The Difficulties of Burial

A small proportion of agrochemical containers are buried on farm; due to pack cleaning prior to burial pesticide residues are minute and will tend to be strongly adsorbed to the soil. Provided pesticide containers are clean, there is unlikely to be any risk arising from pesticides to the environment from burial.

However, the plastics used in agrochemical containers are designed to be robust and are unlikely to degraded for some time as the burial depth is below that of microbial activity. For this reason burial is not the preferred disposal route for plastic containers. It remains a suitable option for cardboard/paper waste and ash from incineration.

Research Needs

Other than the research identified in the associated paper, BAA will be conducting a comparative assessment on the cost in terms of energy, diesel fuel and carbon dioxide emissions for recovering containers from farm.

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